



## REGULAR ARTICLE

# PETIOLAR ANATOMY OF SOME UNSTUDIED EUPHORBIACEAE

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## SUMMARY

Petiole anatomy of 17 species of family Euphorbiaceae representing 17 genera are investigated. The characters such as outline, epidermal characteristics, numbers of cortical layers, patterns of vasculature, occurrence of crystals, tannin, and spheraphides are found to be useful in identification of different taxa.

**Key words:** Petiolar anatomy, Vasculature, Euphorbiaceae

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## 1. Introduction

The family Euphorbiaceae consists of about 283 genera and 7300 species. It is cosmopolitan in distribution, chiefly tropical but extending into temperate regions of Northern and Southern Hemisphere (Lawrence, 1951). Anatomy of the family is investigated by different anatomists (Metcalf and Chalk, 1950; Scott et al, 1960; Hayden and Brandt, 1984; Mennega, 1987; Hayden J., 1994; Hayden and Hayden, 1999). The present authors studied anatomy of some taxa, it is being presented in this paper.

## 2. Materials and Methods

The plants were collected from various places at Nakane Dam, Harsul Forest, Radhanagari, and Dajipur Forest in Maharashtra State. They were also obtained from Government Botanical Garden, Ootakamund (Tamil Nadu). Healthy herbarium materials were received from S I N U Botanical Herbarium, Singapore and Rancho Santa Ana Botanic Garden, Claremont, U. S. A. Preserved plant materials were obtained from Auckland War Memorial Museum Auckland, New Zealand.

The petioles were fixed in F.A.A. and preserved in 70% alcohol. Fresh, preserved and herbarium materials were used. Microtome or free hand sections of middle

part of petiole were stained in 1% safranin and 1% fast green and dehydrated following the method of Johansen (1940). The slides thus prepared were studied under Olympus research microscope. Cellular figures were drawn under low and high power, with the help of prism type of Camera Lucida. They were inked by camligraph or rotoring isograph pens. The permanent slides are deposited in Department of Botany, H.P.T. Arts & R.Y.K. Sci. College Nasik.

## Observations

### 1 - *Acalypha indica* Linn. (Fig. 1)

In T.S. it is broadly circular with nearly flat surface adaxially and shallowly winged. The epidermis is composed of barrel - shaped, equal sized, tightly arranged cells, with outer thick walls and thick cuticle followed from within by 3 - 4 layered collenchyma. Vascular tissue is present in the form of a ring of unequal and collateral vascular bundles embedded in parenchymatous, polygonal and thin - walled conjunctive tissue. The large cells are found in the central portion in between vascular bundles. The thickness of cell wall of conjunctive tissue gradually decreases towards the center of petiole.

**2 - *Agrostistachys indica* Dalz. (Fig. 2)**

In T.S., petiole is broadly circular in outline and channelled on either corner on the adaxial side. Epidermis is the outermost layer and consists of small sized barrel - shaped or rounded cells, outer walls of which are thick with thick cuticle, followed from within 2-3 layered collenchyma. The vascular tissue is in 2 unequal sized prominent central arc with a pair of small sized vascular bundles adjacent to the two ridges on the adaxial side. Both arcs are collateral, capped from outside by 2-3 continuous layered sclerenchyma. The pair of vascular bundles adjacent to the adaxial corners is collateral and capped by sclerenchyma embedded in the conjunctive tissue. A few layers of cells of conjunctive tissue especially lining the abaxial arc are very small elongated and very thin - walled, followed by a few layers of rounded, parenchymatous, thin walled conjunctive tissue. Few additional patches of sclerenchyma are present on adaxial side adjacent to the adaxial arc embedded in conjunctive tissue. The thickness gradually decreases towards the center.

**3 - *Baliospermum axillare* (Wight) Baillon (Fig. 3)**

In T.S., it is nearly circular in outline. Epidermis is composed of rounded barrel - shaped small cells and one layered. Outer thick walls are with thick cuticle followed from within four-layered collenchyma. The vascular tissue is in a discontinuous ring, which is collateral and embedded in the conjunctive tissue. The cells of conjunctive tissue outside the vascular ring are medium sized. The cells of conjunctive tissue present in the center of the petiole are very large, rounded, parenchymatous and thin walled. The thickness of conjunctive tissue decreases centripetally. A few cells of conjunctive tissue outside the vascular ring contain granular matter.

**4 - *Breynia nivosa* (Bull.) Small (Fig. 4)**

In T.S. it is circular in outline. Epidermal cells are squarish or barrel - shaped, unequal in size with thick outer walls and thick cuticle followed from within two-layered

collenchyma. The vascular tissue is in central prominent lunar - shaped vascular arc. It is embedded in large, parenchymatous rounded to polygonal conjunctive tissue. The thickness of the cells gradually decreases centripetally.

**5 - *Bridelia stipularis* Blume (Fig. 5)**

In T.S. it is broadly circular. Epidermis is made up of small rounded or barrel shaped cells. Epidermis is wavy at some places followed from within three-layered collenchyma. Vascular tissue is resolved into a prominent and horse shoe-shaped arc capped by 1-3 layered sclerenchyma from outside embedded in irregular shaped conjunctive tissue. The cells of conjunctive tissue surrounding the vascular arc considerably smaller. Plenty of sphaeraphides containing and tanniferous cells are found in conjunctive tissue. The cells of conjunctive tissue are thin and the thickness is gradually decreases towards the center.

**6 - *Cicca acida* (L.) Merr. (Fig. 6)**

Circular in outline but shallowly furrowed along a central shallow ridge adaxially. Epidermis is composed of fairly large epidermal barrel - shaped, thick walled with thick cuticle cells followed from within two-layered collenchyma. The vascular tissue is in the form of a prominent lunar-shaped central arc embedded in the rounded or polygonal conjunctive tissue. The thickness of cell wall gradually decreases towards inside. Many cells of conjunctive tissue contain tannin.

**7 - *Drypetes venusta* (Wight.) Pax & Hoffm. (Fig. 7)**

Circular in outline but shallowly furrowed on adaxial side. The epidermal cells are smaller but have outer thick walls with thick cutinized followed from inside by three-layered collenchyma. The vascular tissue is a continuous vascular ring in the center, capped from outside by 1-2 layered sclerenchyma embedded in rounded or polygonal, parenchymatous, thin walled conjunctive tissue. The thickness of cell wall

gradually decreases centripetally. Some of the cells of conjunctive tissue contain tannin.

#### 8 - *Euphorbia leucocephala* Lotsy (Fig.8)

In T. S. it is nearly oval - shaped. Epidermis is composed of large barrel - shaped compactly arranged cells with thick cuticle followed from within two-layer collenchyma. The vascular tissue is resolved into three collateral vascular bundles in the center embedded in conjunctive tissue. The cells of conjunctive tissue are rounded or polygonal parenchymatous and thin - walled. The cells of conjunctive tissue which are lined towards the vascular tissues are usually smaller.

#### 9 - *Glochidion hohenckeri* Bedd. (Fig. 9)

It is broadly circular in outline but ridged and furrowed adaxially. The epidermal cells are small, barrel -shaped have outer thick walls and thick cuticle outside followed from inside by 2 - 3 layered collenchyma. The vascular tissue is resolved centrally in a continuous ring but it is open out adaxially is embedded in a polygonal, parenchymatous, thin walled conjunctive tissue. Some cells of collenchyma, conjunctive tissue and phloem cells contain tannin.

#### 10 - *Homalanthus polyandrus* Cheesem (Fig. 10)

It is circular in outline. Epidermis is the outermost layer, single layered, barrel - shaped cells followed from inside with well-developed 4 - 5 layered collenchyma throughout. The vascular tissue is resolved into a ring of eight unequal sized collateral vascular bundles embedded in rounded rarely polygonal parenchymatous, thin - walled conjunctive tissue. The thickness of cell wall gradually decreases towards inside.

#### 11 - *Homonoia riparia* Lour. (Fig. 11)

In T.S. broadly rounded in outline. Epidermis is outermost layer with small barrel-shaped cells. Few unicellular trichomes are present on it. It is followed with well-developed 5-6 layered collenchyma. Some of the collenchymatous cells contain tannin. A vascular tissue is into a ring of six unequal sized vascular bundles

embedded in polygonal or rarely rounded thin walled parenchymatous conjunctive tissue. The thickness of cells to decreases from outside towards the inside. Some the cells are tanniniferous.

#### 12 - *Jatropha panduraefolia* Andr. (Fig. 12)

In T.S. it is oval in shape. The epidermal cells are small sized barrel-shaped, thick walled with thick cuticle followed by 3-4 layered collenchyma. The vascular tissue is in the form of continuous ring embedded in polygonal, parenchymatous medium sized and thin walled conjunctive tissue. The thickness of cell wall gradually decreases inside.

#### 13 - *Kirganelia reticulata* (Poir) Baill. (Fig. 13)

It is broadly oval in shape, but has ridges and grooves. The epidermis is consists of medium sized barrel-shaped cells with outer thick walls and have thick cuticle outside followed from within by 2 - 3 layered collenchyma. The vascular tissue is prominent central collateral vascular bundle embedded in. Many cells of phloem contain tannin. The vascular bundle is embedded in rounded or polygonal, parenchymatous usually thin walled conjunctive tissue. Large number cells of conjunctive tissue are tanniniferous.

#### 14 - *Mallotus stenanthus* Muell - Arg. (Fig. 14)

It is triangular in outline. Epidermis is composed of barrel - shaped large cells. They have outer thicker walls and thick cuticle generally contain tannin followed by four-layered collenchyma. The vascular tissue in to a ring of eight unequal sized collateral vascular bundles, besides the additional bundles inside the ring which resemble medullary bundle of the stem - axis embedded in polygonal, parenchymatous, thin walled uniform conjunctive tissue. Major cells of conjunctive tissue contain granular matter.

#### 15 - *Neoscortechinia kingii* Hook. f (Fig. 15)

In T. S. petiole is circular. Epidermal cells fairly large cells thick with thick cuticle. Glandular trichomes are present all over the epidermis. It is followed from within three-

layered collenchyma. Vascular tissue is in the form of a prominent arc is capped from outside by one or two layered sclerenchyma. The vascular tissue is embedded in large, elongated and thin walled conjunctive tissue. Some of cells of conjunctive tissue contain brownish or pinkish matter. This probably represents secretory cells.

#### 16 - *Securinega virosa* (Roxb. Ex Willd.)

Baillon (Fig. 16)

It is broadly circular. The epidermal cells are of small barrel-shaped thick wall with thick cuticle cells followed from inside by two layered collenchyma. The vascular tissue is resolved into a prominent central more or less lunar shaped collateral vascular bundle

embedded in parenchymatous, thin walled, rounded or polygonal conjunctive tissue.

#### 17 - *Tragia involucreta* Linn - syn *Tragia plukentii* R. Smith (Fig. 17)

It is broadly oval in shape. Epidermal cells are medium sized some are larger and irregularly situated followed by 4-5 layered collenchyma follows the epidermis inside. Vascular tissue is resolved into a ring of unequal - sized collateral vascular bundle embedded in parenchymatous and thin - walled conjunctive tissue. The cells of conjunctive tissue especially situated within the ambit of ring of vascular bundle. Vascular bundles are generally larger than those situated outside the ring of vascular bundle.

Fig. 1-17: Petiole anatomy

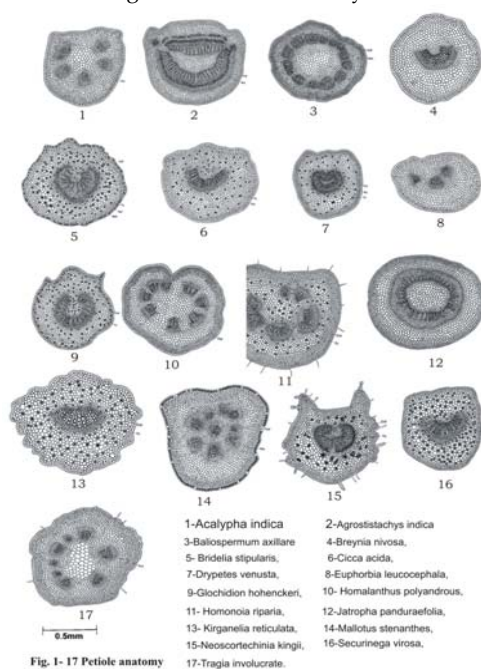


Fig. 1- 17 Petiole anatomy

### 3. Discussion

The leaves are generally petiolar in Euphorbiaceae. In *Acalypha indica* and *Neoscortechinia kingii* they are winged. In *Glochidion hohenkeri*, *Cicca acida* and *Kirganelia reticulata* they are ridged above. Epidermal cells are generally barrel-shaped or rounded but in some cases they are squarish e.g. *Breynia nivosa*. Glandular and eglandular trichomes found on epidermis in

case of *Homonoia riparia*, *Neoscortechinia kingii* and *Tragia involucreta*. Hypodermis is usually collenchymatous, hypodermis is 1- 2 layered in *Breynia nivosa*, *Cicca acida*, *E. leucocephala*, *Securinega virosa*, 2-3 layered in *Drypetes venusta*, *Glochidion hohenkeri*, *Kirganelia reticulata* and *Neoscortechinia kingii*, 3-4 layered in *Acalypha indica*, *Baliospermum axillare*, *Jatropha panduraefolia*, and *Mallotus stenanthos*, 4-5 layered in *Homalanthus polyandrus*, whereas 5 - 6 layered in

*Homonoia riparia*. It is 1-3 layered in *Bridelia stipularis*.

Vascular tissue is lunar or horse- shoe shaped arc in the centre in *Breynia nivos*, *Bridelia stipularis*, *Cicca acida*, *Glochidion hohengerkeri* and *Securinega virosa*. In *Kirganelia reticulata* it is simple central prominent vascular bundle. It is extended in petiolar region as a continuous vascular cylinder in *Drypetes venusta* and *Jatropha panduraefolia*, a ring of 5-8 vascular bundles in the centre in *Acalypha indica*, *Baliospermum axillare*, *Homalanthus polyandrus*, *Homonoia riparia* and *Tragia involucre*, three vascular bundle in *Euphorbia leucocephala*, a ring of 8-13 unequal-sized vascular bundles in *Mallotus stenanthus*. However, in these species additional vascular bundles are found centrally within the ring of bundles in the conjunctive tissue. Such central bundles are also reported in the species of the genus *Mallotus* studied by Khatijah, *et al.* 1996. *Mallotus* shows solitary central bundle. The vascular tissue is capped on adaxial or outside by sclerenchyma. The sclerenchyma is generally in the form of continuous 1-2, 2-3, and 3-4 layers in case of *Drypetes venusta* and *Neoscortechinia kingii*, except *Baliospermum axillare* wherein the sclerenchyma is in the form of 2-3 discontinuous layers. The cells of conjunctive tissue are parenchymatous, polygonal and thin to moderately thick. The cells towards the periphery are usually smaller and increase in size towards the centre. Likewise thickness of their cell wall generally diminishes towards the centre of the petiole. The cells of conjunctive tissue are large to considerably large in *Acalypha indica*, *Baliospermum axillare*, *Bridelia stipularis*, *Euphorbia leucocephala*, *Kirganelia reticulata*, *Securinega virosa* and *Tragia involucre*. The petiole in *Jonnesia principes* shows elongated sacs with wide lumina having brown contents, which occur in the pith surrounded by very small cells resembling an epithelium. Their occurrence is also reported in the species of *Alchornea*, *Givotia*, *Mallotus*, *Pausandra*, *Pogonophora* and *Uapaca* (Metcalf and Chalk, 1950). Similar sacs with wide lumina and brown content were also noted by the present investigators in *Neoscortechinia kingii*, however they are located outside the

vascular tissue but surrounding them. Clustered crystals are found in the conjunctive tissue in *Baliospermum axillare*, *Bridelia stipularis*, *Mallotus stenanthus*, *Securinega virosa*, *Simmondsia chinensis*. Some of show tanniniferous epidermal cells found in *Jonnesia principes*, tannin cells in conjunctive tissue are found in *Bridelia stipularis*, *Cicca acida*, *Drypetes venusta*, *Excaecaria bicolor*, *Glochidion hoheckeri* and *Homonoia riparia*. Tannin cells are present in collenchyma region in *Glochidion hohengerkeri*, *Homonoia riparia*, likewise they are present in phloem cells in *Aporosa lindleyana*, *Glochidion hohengerkeri* and *Kirganelia reticulata*. Vascular anatomy revealed variations as the petioles receives 3-8 vascular bundle or ring of 8-13 or continuous ring generally in members or tribe Crotonae (sensu Benth and Hooker, 1862-1883). In the members of tribe Phyllanthae, the petioles show a continuous ring of vascular tissue or solitary prominent bundle or arc. In the tribe Euphorbieae either ring of vascular bundle of three separate vascular bundle centrally. The tribe Hippomaneae separate 5-8 vascular bundles or ring of vascular bundles. The different stelar configuration of the petioles does not appear tribe specific, however, on additional genera are obviously needed to arrive at some concrete conclusions. Above configuration however can be employed to be distinguishing between the genera at least. Miller & Webster, 1966; Dehgan, 1980, 1982; Dehay, 1935 found resemblance between the Euphorbiaceae on the one hand and Malvaceae, Tiliaceae and related families on the other based on petiolar structure. They also pointed out close relationship between Buxaceae and Euphorbiaceae on the basis of petiolar structure.

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